



Brief Communication

Effect of delayed sleep phase during university life on the daytime functioning in work life after graduation



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ABSTRACT

Objective: To examine the effects of changes in sleep phase on the daytime functioning of new university graduates.

Methods: Questionnaire data of university students ($n = 745$) and university graduates working full time ($n = 360$) were analyzed to explore sleep phase changes during this life stage. The newly graduated full-time workers ($n = 117$) were divided into 2 (bedtime at investigation: earlier/later) \times 2 groups (bedtime at one year prior to investigation: earlier/later), and depressive symptoms and health-related quality of life were compared among groups.

Results: New university graduates experienced ~ 1 h of sleep phase advancement and shortened time in bed compared to one year before investigation. In addition, those who experienced such sleep changes showed larger daytime dysfunction.

Conclusion: Prevention of extreme sleep phase delay during university days might be helpful for students' adaptation to work environment after graduation.

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1. Introduction

Several studies have reported that university students are likely to have a delayed sleep phase [1–3]. For example, Brown et al. [3] found that the prevalence of delayed sleep phase syndrome in university students was 11.5% – about twice the rate found in the general population. Additionally, this delay was reported to be associated with their mental malfunction [4,5], and lower academic performance [4,6,7]. Previous studies have found that the sleep phase of university students is delayed with advancing age or school year [2,5,8], which may imply that the delay would reach a peak in the last year of university life. Since the sleep phase of working adults in their 20s is much earlier than that of university students [2], when they start to work regularly, shortly after graduation, university students are thought to modify their sleep phase to meet job-related demands.

A study exploring the effects of the change of adolescents' sleep phase during the early days of transition from junior to high school suggested that advancement of their sleep phase is likely to cause a lack of nocturnal sleep, leading to the development of daytime sleepiness [9]. Other studies showed that the presence of delayed sleep phase during a certain life stage may have a negative impact on the daytime functioning of the following life stage [10,11]. Considering these findings, there is a possibility that there may be daytime malfunction in new graduate full-time workers due to the sleep phase advancement after university graduation. However, there has been no study exploring this issue. Therefore, in this study, we explored the condition of sleep phase change and its effects on sleep quality, depressive symptoms, and health-related quality of life (HRQOL) in new university graduates.

2. Methods

This study was part of a comprehensive research project on the sleep health of the young generation in Japan. In this cross-sectional study, a web-based questionnaire survey was conducted. It included 3904 participants with different occupations, including students, workers, and unemployed youth, aged 19–25 years. The participants accessed a website to respond to this

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survey; 3613 (93%) completed the questionnaire. In this study, we utilized only data on university students [413 male and 332 female; mean age, 21.52 years; standard deviation (SD), 1.51], and university graduate full-time workers without night shifts (153 male and 207 female; mean age, 23.92 years; SD, 1.02). The study protocol was approved by the ethics committee of the Neuropsychiatric Research Institute, Tokyo, Japan.

Questionnaires consisted of items concerning demographic variables, current and former employment status (e.g. worker, university students), sleep habits and subjective sleep quality, depressive symptoms, and HRQOL. Their sleep habits and sleep quality were assessed with the Japanese version of the Pittsburgh Sleep Quality Index (PSQI) [12,13]. They were also asked about their usual (weekday) bedtime and wake-up time at the time of the investigation. In addition, they were requested to recall their sleep habits from one year prior to the present investigation and report their usual bedtime and wake-up time in that period. Depressive symptoms and HRQOL were assessed using a 12-item version of the Center for Epidemiologic Studies Depression scale (CESD) [14] and Short Form-8 (SF-8) [15], respectively. In this study, the Cronbach's α was 0.92 for the CESD and 0.85 for the SF-8.

Based on the bedtime and wake-up time of the participants, usual time in bed (TIB) was calculated. Total scores of the CESD and PSQI were also calculated. For SF-8, the mental component summary (MCS) and physical component summary (PCS) were calculated. Based on the university grade or duration of full-time work, participants were divided into eight groups: 1st, 2nd, 3rd, or ≥ 4 th year university students and 1st, 2nd, 3rd, or ≥ 4 th year of working after graduation. Average bedtime, wake time, and TIB (at the time of the investigation and at one year before investigation) were compared using 2 (time points: current vs one year before) \times 8 (university grade/work duration: 1st year students to ≥ 4 th year worker) two-way analysis of variance (ANOVA). If the main and/or interaction effect of the university grade or work duration was significant, post-hoc analysis was conducted using the Bonferroni correction. To explore the impact of sleep phase change after graduation on daytime functioning and sleep quality, newly university graduated full-time workers ($n = 117$) were divided into two groups according to the median values of their current bedtime (24:00) and bedtime at one year before (25:00), respectively. Then, CESD, PSQI, MCS, and PCS scores were compared using 2 (earlier/later bedtime at one year before) \times 2 (earlier/later current bedtime) ANOVA. The same analyses were conducted on their reported wake time and TIB, using their median at each time point (current wake time, 07:00; wake time at one year before, 08:00; current TIB, 06:30; TIB at one year before, 07:30) for classification.

3. Results

The sleep phase was gradually delayed with advancing grade of university classes; however, it was found to be advanced after graduation (Fig. 1). The two-way ANOVA showed significant interaction effects between grade and time points at bedtime [$F(7, 1064) = 18.05, P < 0.001$]. A subsequent simple main effects test showed that habitual bedtimes reported by 1st, 2nd, 3rd, and ≥ 4 th year students at investigation were significantly later than what they reported one year before the investigation. In contrast, newly graduated full-time workers reported an earlier current bedtime than at one year before ($P < 0.001$). In addition, the interaction was significant with regard to wake time, [$F(7, 1064) = 26.41, P < 0.001$]. Simple main effects tests showed that the difference between current wake time and that one year before was significant in 1st and ≥ 4 th year students and newly graduated workers ($P < 0.001$ for all the tests). The interaction was also significant for TIB [$F(7, 1064) = 6.015, P < 0.001$]. Subsequent simple main effects analyses showed that the

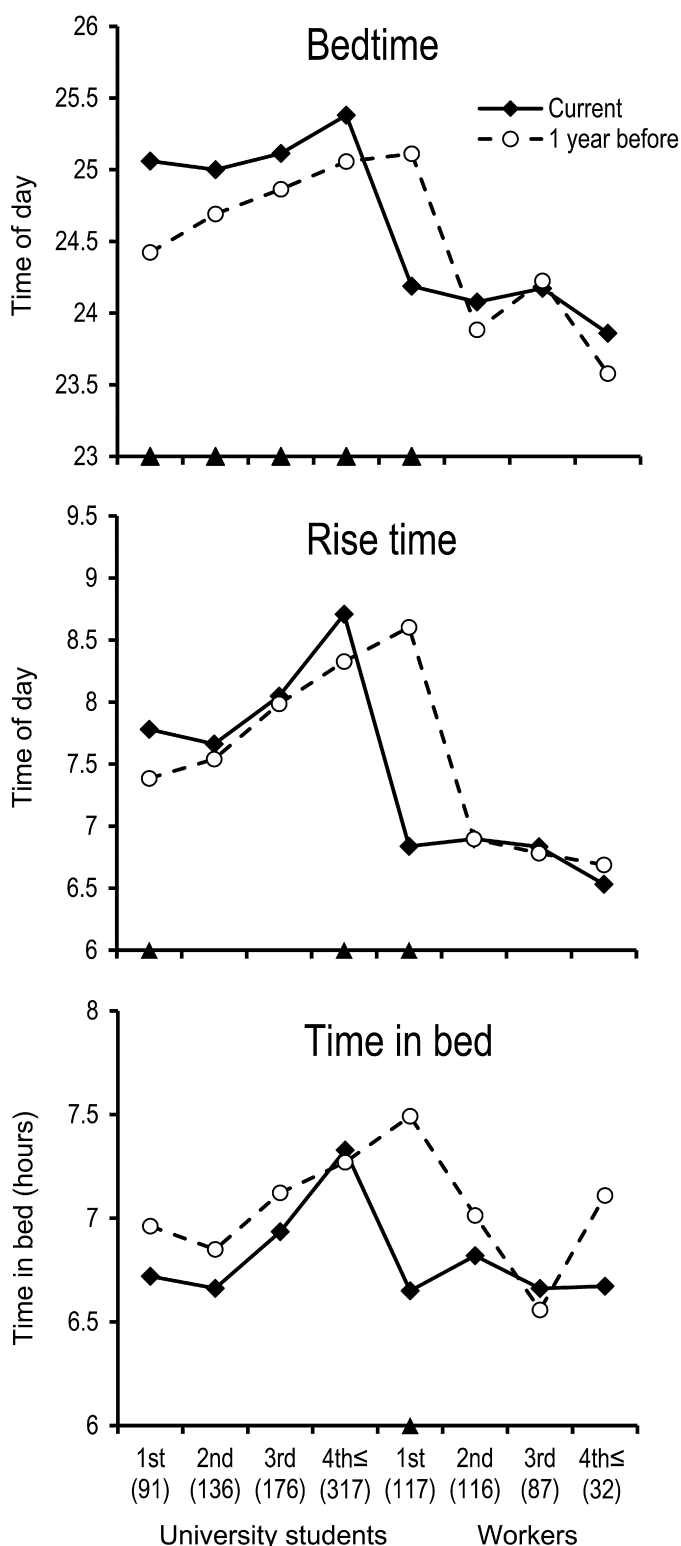


Fig. 1. Reported bedtime (upper panel), wake time (middle panel), and time in bed (lower panel) on weekdays at the time of the investigation and at 1 year before it. Triangles (▲) on the abscissa indicate significant differences between the current and 1-year-before sleep parameter in each year-grade group. Values in parentheses are numbers of participants in each group.

difference between current TIB and that one year before was significant only in new graduates ($P < 0.001$).

The two-way ANOVA with the data on newly graduated full-time workers revealed that the interaction between current bedtime

Table 1

CESD, MCS, PCS, and PSQI scores for each group based on the reported current and for one-year-before bedtimes.

	Bedtime of one year before				Results of simple main effects analyses
	Earlier ($\leq 25:00$, $n = 68$)		Later ($25:00 <$, $n = 51$)		
	Current bedtime earlier (EE) ($\leq 24:00$, $n = 47$)	Current bedtime later (EL) ($24:00 <$, $n = 21$)	Current bedtime earlier (LE) ($\leq 24:00$, $n = 21$)	Current bedtime later (LL) ($24:00 <$, $n = 30$)	
CESD ^{a,b}	4.60 (6.91)	5.10 (6.27)	10.50 (9.14)	4.59 (5.73)	EE < LE LL < LE
MCS ^a	48.53 (9.16)	44.53 (8.88)	41.28 (10.41)	48.12 (6.22)	LE < EE LE < LL
PCS	51.87 (6.46)	51.55 (5.66)	50.82 (6.90)	52.21 (5.28)	
PSQI ^a	4.64 (2.53)	5.52 (1.94)	6.25 (2.43)	5.24 (2.42)	EE < LE

CESD, Center for Epidemiologic Studies Depression; MCS, Mental Component Summary Score of Short-Form-8; PCS, Physical Component Summary Score of Short-Form-8; PSQI, Pittsburgh Sleep Quality Index.

^a Significant interaction between current and one-year-before bedtimes.

^b Significant main effect of current bedtime. Values in parentheses are standard deviations.

and that at one year before was significant for the scores of CESD [$F(1, 113) = 5.52$, $P < 0.05$], MCS [$F(1, 113) = 10.09$, $P < 0.01$], and PSQI [$F(1, 113) = 4.10$, $P < 0.05$], but not for PCS (Table 1). Subsequent simple main effect tests revealed that in new graduates with earlier current bedtime ($\leq 24:00$), those who reported later bedtime at one year before the study ($25:00 <$) had higher CESD and PSQI scores and lower MCS score than those who reported earlier bedtime ($\leq 25:00$) one year before ($P < 0.05$ for all the tests). The ANOVAs showed no significant main effects or interactions between current wake time and that for one year before, as well as current TIB and TIB one year before, on any dependent variables.

4. Discussion

As expected, new university graduates experienced ~ 1 h of sleep phase advancement, which was accompanied with shortened TIB during a year after being engaged in full-time work. It was speculated that this advancement would occur due to the modification in their sleep–wake pattern to match the one suitable for full-time workers. However, the new graduates who experienced bedtime advancement during a year had a tendency to have psychological malfunctions, as well as disturbed sleep quality after their graduation. This result is consistent with that of an earlier study revealing that advancement of sleep phase was associated with daytime malfunction in early adolescents [9]. Interestingly, in contrast to the change in bedtime observed in the present study, the change in TIB seemed to have no significant impact on new graduates' malfunctions. Thus, as compared with the change in sleep duration, the change in sleep phase had a more serious impact on the daytime function in the new work life after graduation. The reason for this phenomenon is unclear; however, the desynchronization between the internal circadian clock and the sleep–wake cycle might contribute to the occurrence of daytime malfunctions in new university graduates.

In line with previous studies, which emphasized the importance of sleep education for health and academic performance among university students [4,16,17], the present results suggest that sleep education for preventing extreme delay in sleep phase might also be helpful for university students to enable them to adapt to work life after graduation. On the other hand, wake-up time had no effect on participants' malfunction after graduation. This phenomenon might have emerged partly because bedtime can be self-determined by the students or workers, but wake-up time may be prone to being determined by social regulation (e.g. start time of lecture in university or office hours). Therefore, it is possible that, rather than wake time, the bedtime of university students reflected their internal circadian phase.

This study, however, had some limitations. First, possibility of recall bias could not be neglected for our study sample that was obtained by web-based recruitment. In particular, the reliability of reported sleep habits at one year before might be somewhat problematic. In addition, the causal relationships between the change in sleep phase and daytime dysfunction remain unclear. In this study, we had no data about the weekend sleep phase at one year before, which limited us to explore the details of past sleep habits (e.g. regularity of sleep–wake pattern, sleep debt), and to estimate the prevalence of delayed sleep phase syndrome at one year before. Future longitudinal studies with larger sample numbers from the undergraduate to the postgraduate periods would be necessary to draw definite conclusions.

In conclusion, our data suggest that sleep phase advancement after university graduation might lead to maladaptation in the work life after graduation. Preventing extreme sleep phase delay in university students could be essential for helping graduates to start their work life as a full-time worker in a better fashion.

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Conflicts of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <http://dx.doi.org/10.1016/j.sleep.2014.05.017>.

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